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Hydrology and Earth System Sciences Discussions

Interactive comment on "A multi-scale soil water structure model based on the pedostructure concept" *by* E. Braudeau et al.

Anonymous Referee #1

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Two preliminary remarks about curve-fitting in soil science and hydrology. 1. Curve-fitting and physics Curve-fitting (a) only requires a standard statistical handling; (b) sometimes can be useful for engineering applications after "calibration"; (c) gives some possible mathematical description of observations (i.e., description of a "curtain"), but nothing for understanding their physical reasons (what lies behind the "curtain"?). Physics requires (a) a construction of new physical models; and (b) their substantiation by comparison between prediction and observation (without fitting). Comment: curve-fitting is somewhat easier, thus explaining its wide-spread use.

2. Different curve-fittings (a) An improvement of curve-fitting (by formally increasing goodness of fit, r2) is physically meaningless when the fitted curve is already within the limits of experimental errors. (b) The comparison between two different fitting models

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(by r2 values) is physically meaningless when their fitted curves are already within the limits of experimental errors. Both are equally "good". Comment: usually in such "improvements" and "comparisons" the experimental errors are even not mentioned; that is, their physical value is zero.

Remarks about major previous works that are the basis of the manuscript in light of the preliminary remarks 1. The approach is based on dependable data of continuous monitoring of soil sample shrinkage and water retention as well as curve-fitting (see preliminary remark 1). 2. The XP model (Braudeau, 1988; Braudeau et al., 1999) is a starting point of the approach. The model uses a formal geometrization of the experimental shrinkage curve based on a number of rigid limitations (assumptions): a. The shrinkage curve is only approximated as a set of linear and curvilinear sections with smooth transitions between them. b. The curvilinear sections are described by expressions of a similar mathematical structure. c. Transition points (SL, AE, ML, MS) should have a physical meaning. Curve-fitting (in a general case, 11 fitted parameters), of course, gives excellent results with high r2 (see preliminary remark 2a) and indicates transition points. However, the statements of the model about the structural shrinkage area, role of macroporosity (ML – macroporosity limit point), and the position of the maximum swelling point (MS) are doubtful and arbitrary. They are the consequences of the arbitrary postulated geometrical limitations and formal fitting, but not of the laws of nature. Comparison (Boiven et al., 2006, SSSAJ) of XP curve-fitting with another curve-fitting of shrinkage curves from Peng and Horn (2005, SSSAJ) found "preference" for the XP model (see preliminary remark 2b). 3. XP-PS model (Braudeau et al., 2004, SSSAJ). The PS concept is totally based on XP fitting and is a more refined formulation of the same fitting. PS is a "mansard" of XP "construction". The key point of the PS concept is the introduction of limiting and specific assumptions of a water partition between different water pools in a so-called pedostructure (PS) at a given water content. These assumptions are introduced without any preliminary argumentation (as it should be if one is speaking about scientific assumption, but not arbitrary fantasy) and are formally similar to the laws of radioactive atom decay (this analogy is not noted in Braudeau et al., 2004). The role of time in the decay now passes to water content. The role of the radioactive atom number at a given moment passes to the number of (exotic) "active sites" that are occupied by water at a given water content. The role of the characteristic time of semi-decay passes to the corresponding coefficient. However, the necessary condition of the radioactive decay law is the homogeneity of the decay process along the time axis. That is, the relative number of decays per unit time is constant. At the same time it is clear that in the case of soil shrinkage, homogeneity along the water content axis (this is an analog of the time) is a myth. The view of the shrinkage curve of an aggregated soil shows that. Such an "assumption" can only exist "inside" XP because all parameters connected with this assumption are calculated through XP fitted parameters. 4. XP-PS+water retention+swelling kinetics (Braudeau and Mohtar, 2004, WRR; 2006, SSSAJ). The expressions from XP-PS (see remarks 1-3) are used in wordy discussions of the role of water films in soil water retention accounting for soil swelling kinetics, creating an impression about physical considerations. However, all is eventually reduced to the usual multi-parametrical curve-fitting that buries all physics and is no better than another curve-fitting (see preliminary remark 2b) of soil water retention curves (e. g., Boiven et al., 2006, SSSAJ).

Remarks about the manuscript submitted This work repeats, in general, the contents of previous works [major works (XP+PS+water retention+swelling kinetics) and other secondary details] and adds a number of empirical expressions for hydraulic conductivity (starting from those of 50 years old) as well as some general words about fissures and thermodynamics. All that is presented as a general solution ("Kamel") to all soil hydrology problems. The authors even suggest that the "Kamel" is an etalon (!?) ("...as a standard reference to evaluate other soil-water models..."- see the last lines of Conclusions, p.1140). The authors should be congratulated for such a marvelous achievement – the completion of soil hydrology as engineering applications and a science. Nevertheless, at most, this work can be considered to be a rough approach to some engineering applications. It is sad if all this is perceived by the Soil community as a "Big Science".

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